DOCUMENT RESUME

ED 050 720 JC 710 155

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TITLE Some Variations in Probabilities of Success, Failure and Dropout.
PUB DATE 71
NOTE 26p.; Seminar paper

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS Academic Achievement, Academic Failure, Autoinstructional Aids, *Dropout Prevention, *Dropout Research, *Dropouts, *Junior Colleges
IDENTIFIERS California

ABSTRACT

The ultimate purpose of studying the problem of students dropping courses is to develop a method of minimizing their number and maximizing the number of those succeeding in courses. The purpose of this preliminary study is to analyze presently available data in terms of success, failure, and dropping of courses. Data were obtained from the grade records in all math courses taught at El Camino College (California) from the fall 1963 semester through the fall 1970 semester. Results indicate that: (1) success increases and dropouts decrease as students progress through mathematics courses; and (2) the dropout problem is one for the student, counselor, and teacher. It is the author's intention to attack this problem through the use of self-instructional material. He recommends that all community college instructors examine the success, failure, and dropout rates in their classes and make an effort to increase successes and decrease dropouts. (CA)

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ED050720

SOME VARIATIONS IN PROBABILITIES OF SUCCESS, FAILURE AND DROPOUT

Research Project Presented
in Partial Fullfillment
of the Requirements
for
Education 441 D
Spring 1971

JC 710 155

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LOS ANGELES
JUL 7 1971
CLEARINGHOUSE FOR
JUNIOR COLLEGE
INFORMATION

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SOME VARIATIONS IN PROBABILITIES

OF

SUCCESS, FAILURE AND DROPOUT

THE PROBLEM

Currently there is much talk about educational accountability. College and University budgets are being drastically curtailed and school bond issues have been turned down by the voters. Educational institutions everywhere are scurrying around trying to find every means possible to save money. One source of increasing the cost per student in Community Colleges is the fact that many students enroll in classes that they do not complete. For example; it is estimated that it costs $2.07 per student per hour to educate students at El Camino College. Therefore, if one student drops a 3 unit class which meets 15 weeks for 3 hours per week, he has cost the district $93.00, and gained nothing. The problem, as I see it, is basically a performance problem of the type discussed by Robert F. Mager in Analyzing Performance Problems or 'You Really Oughta Wanna'.[9] We have here a discrepancy between an actual and a desired result. It is desired that a student complete the course in which he enrolls. When a student does not complete the course, we have a discrepency.

If we could eliminate this discrepancy, then the cost per student would diminish because more students would be completing their courses at no additional cost for the teacher time or equipment necessary for the course.

THE PURPOSE

The ultimate purpose in studying the problem of students dropping courses is to develop some method of minimizing the number of dropouts, and maximizing the number of students succeeding in the courses. The purpose of this preliminary study is to analyze presently available data in terms of success, failure, and dropping of courses.

As a result of this preliminary study and other analyses I have completed it is my intention to attack the problem of minimizing dropouts and maximizing successes through the implementation of self-instructional material.

THE METHOD

The method of investigating this problem involved the following procedures:

1. Review of literature.
2. Collection of data.
3. Analysis of data.

Review of Literature

In reviewing literature, the most productive source of information turned out to be the ERIC documents.

The ERIC files contain a vast variety of studies of academic achievement and studies of dropouts. For example; Nancy Bush Preas did her doctoral dissertation on "A Study of the Relationship

between Selected Variables and Academic Achievement in a Community College."[11] Her study was based on the assumption that academic achievement can be measured, estimated, and predicted with accuracy. She used the following six predictors: SAT - Verbal, SAT - Mathematics, English Coop, Mathematics Pre-Test, High School Grade Point Average, and High School Rank. In a survey of 50 Community Colleges conducted by Dean W. Seibel[13] in 1966, he found that 96% of all junior colleges surveyed administered achievement tests in English and Mathematics to entering students for the purpose of placement in courses. This indicates that at least an effort is made to properly place students in courses at a level most conducive to their succeeding.

In a study of "Some Dimensions of the Drop-Out Problem in Apprenticeship Training"[8] done by Ronald W. Johnson for the New Brunswick Department of Labor at Fredericton in 1967, he used data from existing files and from a questionnaire filled in by former employers and district supervisors. He found that apprentices completing training were significantly older and had more dependents. He stated that although discrepancies appeared on the questionnaires, it appeared that the dropouts did not lack intelligence or adequate education, but did lack interest, which showed up in poor attendance, frequent illness, and tardiness.

In a study carried out in 1970 by Michael Szabo and John F. Feldhusen[5], they used the method of applying a modified multiple regression model to data regarding intellective and personality

variables as related to success in an independent study science course. By use of the multiple regression analysis they found the most stable predictors to be the restraint scale of the Guilford-Zimmerman Temperament Survey, high school rank, SAT - Verbal, CEEB - Mathematics, and high school social studies grade.

In The Public Junior College, The Fifty-fifth Yearbook of the National Society for the Study of Education[1], Lawrence L. Bethel reports that many junior colleges have a high dropout in vocational programs because of high employment opportunities, even before the individual has completed his vocational preparation. He also points out that the foremost concern of the junior college is to prepare the student at least adequately in terms of general breadth and specific skills.

As a result of reviewing literature about retention and dropouts, it is obvious that most studies are concerned with dropping out of total programs, or predicting success in college. My concern is not that broad. I intend to attack the problem right at its source -- the individual classroom. I am concerned about students dropping specific courses, rather than whole programs or completely out of college.

Collection of Data

Collection of the data was not the simple task I had expected it to be. Due to a lack of communication and bureaucratic red tape my acquisition of some desireable data was impeded to such a degree that I was forced to use an alternate source of data.

Therefore, two different sets of data were actually analyzed. All of the data analyzed were made available through the co-operation and help of Henry Mansfield, Jr., Dean of Mathematics and Engineering at El Camino College.

The data actually analyzed were obtained from grade records in all Mathematics courses taught at El Camino College from the Fall Semester, 1963 through the Spring Semester, 1968, excluding all Summer Sessions. Additional data were analyzed for the Elementary Probability and Statistics course (Mathematics 7) from its inception in Spring, 1964 through Fall, 1970, excluding the 1970 Summer Session for which the data were unavailable.

The data about all Mathematics courses were analyzed by three major categories - High School level courses, Calculus courses, and Other courses. The number of students in each category are as follows:

High School	-	20,141
Calculus	-	7,666
Other	-	4,864
Total		32,671

The Mathematics 7 data involved a total of 1376 students, 648 from Fall Semesters, 567 from Spring Semesters, and 161 from Summer Sessions.

Analysis of Data

The data regarding all Mathematics courses was initially analyzed by individual courses. Probabilities of success, failure,

and dropping a course were determined for each course. For this analysis the following definitions will be used: success is defined as a grade of C or better, failure is defined as a grade of D or F, and dropping includes all W grades (W indicates withdrawal) or NG which represents no grade.

The method of analysis actually applied to these data was to set 95% confidence limits on probability estimates of success, failure, and dropping of each Mathematics course, and then determine whether or not these limits actually included the value for the population considered.

The courses were broken down into three major categories: 1) High School level courses, 2) Calculus courses, and 3) Other courses. Each category was considered as a population, and the separate courses in each population were compared within their own population.

A graphical comparison of probability versus grade level of the course was carried out for probabilities of success, failure, and dropping a course. Another graphical analysis was done for probability versus time for the Elementary Algebra course.

More complete information was available regarding the Mathematics 7 course (Elementary Probability and Statistics). For this course the hour of the day each class section was taught was available, along with a teacher code number.

A statistical test of the null hypothesis that the probabilities did not differ for day classes versus night classes was made for success, failure and dropping the course. Chi-square

analyses were carried out to determine whether or not there was any variation by semesters, or by teachers. The regular semester Mathematics 7 classes (excluding summer classes) were used to establish probabilities of success, failure, and dropping. Ninety-five percent confidence limits were determined for these probabilities. Corresponding probabilities were then established for each teacher and checked to ascertain whether or not they fell within the 95% confidence limits set by the regular semester population.

ANALYTICAL RESULTS

These results are presented here in two parts: 1. Results of analysis of all regular semester mathematics courses taught at El Camino College from the Fall Semester, 1963 through the Spring Semester, 1968. 2. Results of analysis of Mathematics 7 data at El Camino College from Spring, 1964 through Fall, 1970.

Part 1

In this analysis conservative 95% confidence limits were set on individual course probability estimates. The formula used to set the limits was $\left(\bar{p} \pm \frac{1}{\sqrt{n}}\right)$.[10] The tabulations on the following pages summarize these results for each of the categories, High School Courses, Calculus Courses, and Other Courses.

RESULTS OF SETTING 95% CONFIDENCE LIMITS ON PROBABILITIES OF SUCCESS, FAILURE, AND DROPPING OF MATHEMATICS COURSES

SUMMARY FOR HIGH SCHOOL COURSES

Population Data:

Total Number of Students	= 20,141	
Total Number of A,B,C grades	= 7,417	p_S = .368
Total Number of D,F grades	= 4,593	p_F = .228
Total Number of NG,W grades	= 8,040	p_D = .399
Total Number of Incompletes	= 91	p_I = .005

		Summary of A,B,C grades			Summary of D,F grades				Summary of NG,W grades			
Course	n	p_S	Low Limit	High Limit	High Low	p_F	Low Limit	High Limit	High Low	p_D	Low Limit	High Limit	High Low
A	8038	.30	.29	.31	Low	.21	.20	.22	Low	.48	.47	.49	High
B	1400	.39	.36	.42		.15	.12	.18	Low	.45	.42	.48	High
D	3679	.44	.42	.46	High	.24	.22	.26		.32	.30	.34	Low
C	2311	.40	.38	.42	High	.26	.24	.28	High	.34	.32	.36	Low
25A	2238	.33	.31	.35	Low	.30	.28	.32	High	.35	.33	.37	Low
25B	914	.38	.35	.41		.27	.24	.30	High	.35	.32	.38	Low
40	1561	.52	.49	.55	High	.17	.14	.20	Low	.30	.27	.33	Low

RESULTS OF SETTING 95% CONFIDENCE LIMITS ON PROBABILITIES OF SUCCESS, FAILURE, AND DROPPING OF MATHEMATICS COURSES

SUMMARY FOR CALCULUS COURSES

Population Data:

Total Number of Students	= 7,666	
Total Number of A,B,C grades	= 3,230	p_S = .421
Total Number of D,F grades	= 1,885	p_F = .246
Total Number of NG,W grades	= 2,528	p_D = .330
Total Number of Incompletes	= 23	p_I = .003

		Summary of A,B,C grades			Summary of D,F grades				Summary of NG,W grades			
Course	n	p_S	Low Limit	High Limit	High Low	p_F	Low Limit	High Limit	High Low	p_D	Low Limit	High Limit	High Low
1A	2835	.33	.31	.35	Low	.32	.30	.34	High	.35	.33	.37	
1B	1348	.40	.37	.43		.23	.20	.26		.37	.34	.40	High
1C	691	.58	.54	.62	High	.17	.13	.21	Low	.24	.20	.28	Low
5A	1128	.37	.34	.40	Low	.23	.20	.26		.40	.37	.43	High
5B	408	.52	.47	.57	High	.18	.13	.23	Low	.29	.24	.34	
6A	762	.55	.51	.59	High	.19	.15	.23	Low	.26	.22	.30	Low
6B	494	.62	.57	.67	High	.17	.12	.22	Low	.20	.15	.25	Low

RESULTS OF SETTING 95% CONFIDENCE LIMITS ON PROBABILITIES OF SUCCESS, FAILURE, AND DROPPING OF MATHEMATICS COURSES

SUMMARY FOR OTHER COURSES

Population Data:

Total Number of Students	= 4,864	
Total Number of A,B,C grades	= 2,668	p_S = .548
Total Number of D,F grades	= 716	p_F = .147
Total Number of NG,W grades	= 1,462	p_D = .301
Total Number of Incompletes	= 18	p_I = .004

	Summary of A,B,C grades				Summary of D,F grades				Summary of NG,W grades			
Course	n	p_S	Low Limit	High Limit	High Low	p_F	Low Limit	High Limit	High Low	p_D	Low Limit	High Limit	High Low
1	887	.48	.45	.51	Low	.20	.17	.23	High	.32	.29	.35	
4	563	.51	.47	.55		.18	.14	.22		.31	.27	.35	
7	578	.42	.38	.46	Low	.12	.08	.16		.46	.42	.50	High
8	32	.44	.26	.62		.00	.00	.18		.56	.38	.74	High
10	540	.56	.52	.60		.14	.10	.18		.30	.26	.34	
38A	1541	.60	.57	.63	High	.14	.11	.17		.25	.22	.28	Low
38B	723	.65	.61	.69	High	.11	.07	.15		.24	.20	.28	Low

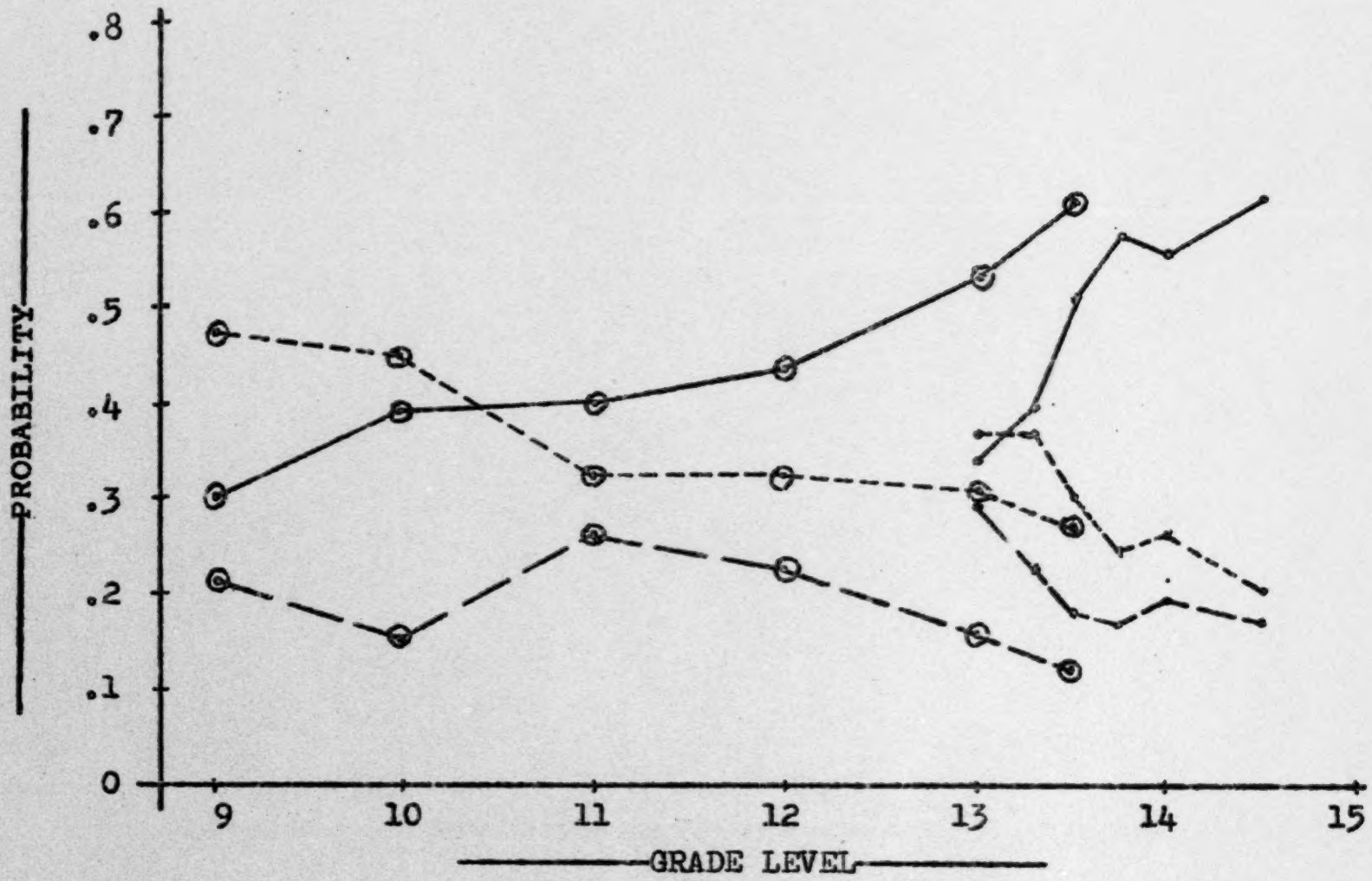
In the analysis by grade level, one course (Mathematics 8 - Linear Algebra) was excluded because it was only offered twice on an experimental basis, and only had 21 students in the Spring of 1967 and 11 students in the Spring of 1968. The courses were assigned grade levels as follows:

Grade Level	Course
9	A
10	B
11	D, 25A
12	C, 25B, 40
13	1A, 5A, 1, 4, 7, 38A
13.3	1B
13.5	5B, 10, 38B
13.7	1C
14.0	6A
14.5	6B

The fractional grade levels were used on the college level courses where they were part of a year sequence. For example; 1A, 1B, and 1C covers the same material that 5A, 5B does. Since both sequences are actually the first year of college calculus, the 1A, 1B, 1C sequence was assigned levels of 13, 13.3, and 13.7, while the 5A, 5B sequence was assigned 13.0 and 13.5. The high school level courses were assigned the grade level at which they are usually taught in high school.

The graph on the following page shows the probabilities of success, failure, and dropping versus grade level for two kinds of classes. The calculus courses are shown separately from grade 13 through 14.5. All other mathematics courses are graphed from grade 9 through 13.5.

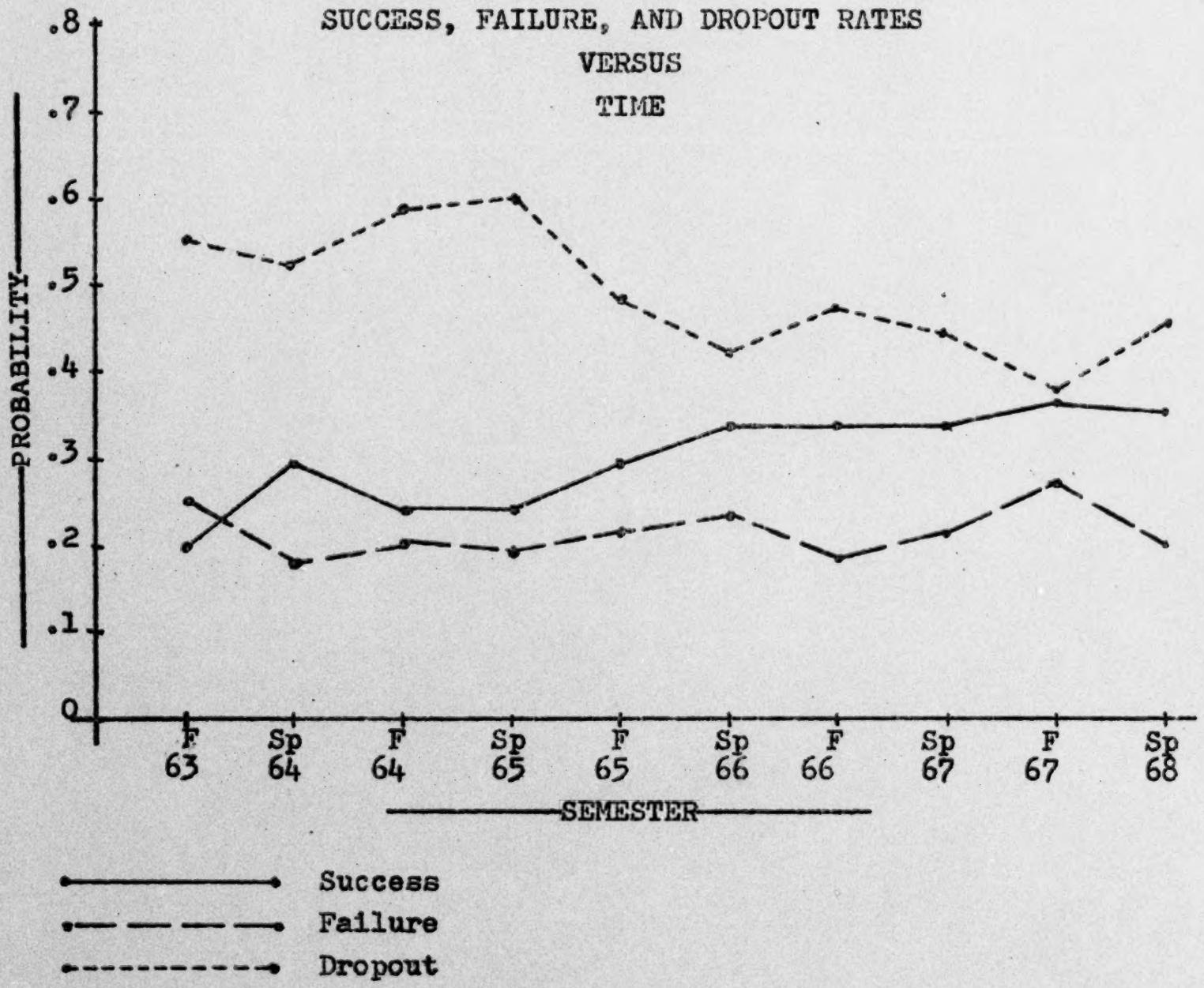
PROBABILITY VERSUS GRADE LEVEL
FOR
SUCCESS, FAILURE, AND DROPPING



p_S All Mathematics courses except Calculus
p_S All Calculus courses only
p_F All Mathematics courses except Calculus
p_F All Calculus courses only
p_D All Mathematics courses except Calculus
p_D All Calculus courses only

Based on 10 regular semesters at El Camino College - Fall, 1963 through Spring, 1968. (All probabilities are based on initial enrollments, thus eliminating a bias due to no grade (NG) drops.)

Since the Elementary Algebra course (Mathematics A) involved several changes and much experimentation over the period of time studied, I decided to examine a graph of the success, failure, and dropout probabilities as related to time. The graph is shown below.



Part 2

The analysis of the Mathematics 7 classes comparing the day and night classes produced the following table showing numbers of successes, failures, and drops.

	Day Classes	Night Classes	Totals
Number of Successes	391	302	693
Number of Failures	81	32	113
Number of Drops	306	264	570
Totals	778	598	1376

A similar table showing corresponding probabilities and calculated Z - values using the formula[14] -

$$Z = \frac{P(day) - P(night)}{\sqrt{[P(total)][1-P(total)]\left[\frac{1}{N(day)} \quad \frac{1}{N(night)}\right]}}$$

is shown here.

	Day Classes	Night Classes	Day and Night Combined	Z
P(Success)	.502	.505	.505	.011
P(Failure)	.104	.054	.079	.342
P(Drop)	.393	.440	.415	.176

The Chi-square analysis for semester variation resulted in the following table showing observed values and expected values for numbers of cases. The expected values are shown in parentheses.

	Fall	Spring	Summer	Totals
Number of Successes	314 (326)	289 (285)	90 (81)	693
Number of Failures	55 (53)	52 (46)	6 (13)	113
Number of Drops	279 (269)	226 (236)	65 (67)	570

The calculations resulted in a Chi-square value of 5.987, with 4 degrees of freedom. Since Summer Sessions produced a Chi-square value of 4.835 contributing to the total of 5.987, a second Chi-square analysis was carried out to compare Regular Semesters as one group versus Summer Sessions. This resulted in a Chi-square value of 5.587, with 2 degrees of freedom.

The Chi-square analysis for teacher variation was done from the following table of observed and expected values.

Instructor No.	28	31	49	51	73	75	Totals
Number of Successes	83 (69)	347 (326)	39 (68)	84 (83)	27 (39)	23 (19)	603
Number of Failures	18 (12)	41 (58)	25 (12)	14 (14)	9 (7)	0 (3)	107
Number of Drops	37 (57)	269 (273)	73 (57)	69 (70)	42 (32)	15 (16)	505

This table resulted in a Chi-square value of 61.57, with 10 degrees of freedom. Since one teacher alone contributed a Chi-square value of 30.99 to the total value of 61.57, it was decided to examine these data in terms of conservative 95% confidence limits. This resulted in the following table.

RESULTS OF SETTING 95% CONFIDENCE LIMITS ON PROBABILITIES OF SUCCESS, FAILURE, AND DROPPING OF ELEMENTARY PROBABILITY & STATISTICS COURSE

SUMMARY FOR INSTRUCTORS

Population Data:

Total Number of Students = 1,215

Total Number of A,B,C grades = 603 $p_S = .496$

Total Number of D,F grades = 107 $p_F = .088$

Total Number of NG,W grades = 505 $p_D = .416$

Conservative 95% Confidence Limits on p_S, p_F, and p_D:

$.467 < p_S < .525$ $.059 < p_F < .117$ $.387 < p_D < .445$

		Summary of A,B,C grades		Summary of D,F grades		Summary of NG,W grades	
Instr.	n	p_S	Result	p_F	Result	p_D	Result
28	138	.602	Above Limits	.130	Above Limits	.268	Below Limits
31	657	.529	Above Limits	.061	Insignificant	.410	Insignificant
49	137	.285	Below Limits	.182	Above Limits	.533	Above Limits
51	167	.503	Insignificant	.084	Insignificant	.413	Insignificant
73	78	.346	Below Limits	.115	Insignificant	.539	Above Limits
79	38	.606	Above Limits	.000	Below Limits	.394	Insignificant

CONCLUSIONS

The charts showing the 95% confidence limits indicate that considorable variation exists in the success, failure and dropout probabilities. Examination of the same data graphically (see graph on page 13) show a definite relationship between the probabilities and grade level of the course. The success rate improves as the level rises and the dropout rate decreases for higher level courses. This is only what is to be expected, since the better students are going on to the higher levels. The cream is rising to the top. However, some of the cream sours at the start of the calculus sequence of courses. While all other courses have a probability of success equal to .53 at the grade 13 level, the calculus success rate is only .34, which is between the success rates for levels of 9 and 10. From grade 13 level on through the calculus sequence the pattern established by the other courses is duplicated.

The graph (see page 14) showing the elementary algebra rates for each semester sequentially depicts a marked increase in the success rate with a corresponding decrease in the dropout rate. Whether this was serendipital or not is unkown. Retrospective examination revealed that in the Fall of 1965, half of the elementary algebra classes were taught in large groups of 100, and the other half in regular classes of 30 students. In the Spring of 1966 and thereafter, all of the elementary algebra classes were taught in groups of 125 students. In all cases, the large groups of 100 and 125 were taught by a team of two teachers. It must

also be pointed out that team teaching was not the only innovation over this period of time. Textbooks were changed several times, the examinations were changed, and even the course content was somewhat revised. Another effect which should not be overlooked is that changing to team teaching methods moved some teachers out of the elementary algebra course.

The analysis of the elementary probability and statistics course data revealed the fact that there is no significant difference in the probabilities of success, failure and dropout when comparing night and day classes. The calculations gave standard normal distribution Z values of .011, .342, and .176 respectively for differences in success, failure and dropout.

Two Chi-square analyses of the data by semesters revealed no dependence on semesters for the numbers of successes, failures or dropouts. The first of these was calculated for Fall, Spring and Summer semesters separately and resulted in a Chi-square value of 5.987 with 4 degrees of freedom. At the .05 level of significance, the critical value for Chi-square is 9.488. Since the Summer Session data produced over 80% of the total Chi-square value of 5.987, a second Chi-square value was calculated comparing two semester categories instead of three. This comparison of regular versus summer resulted in a Chi-square value of 5.587, which is still insignificant at the .05 level where the critical value is 5.991 for two degrees of freedom. However, it is significant at the .10 level of significance. This may be due to the fact that the student population is somewhat different

for this particular course in the summer. Some of the summer students are from four-year colleges, some of them are even graduate students, and some are advanced placement high school students.

The Chi-square analysis for teacher variation showed a great deal of variation exists among teachers. The Chi-square value for 10 degrees of freedom turned out to be 61.57. The critical value at the .05 level is only 18.307. Even at the .005 level the critical value is only 25.188, much less than the calculated value of 61.57. One outstanding feature of this comparison was that one teacher alone contributed a Chi-square value of 30.99 to the total value of 61.57.

The setting of 95% confidence limits on the probabilities of success, failure and dropout revealed that the same teacher who contributed the largest value to the Chi-square total was below the lower confidence limit for success, and above the higher limit in both the failure and dropout categories. This analysis also showed that only one of the six teachers involved had probabilities that fell within the 95% limits in all three categories.

SUMMARY

The purpose of this study was to analyze available data in terms of success, failure and dropping of individual courses. The literature review carried out revealed that there is a great deal of information available concerning dropout studies and prediction of academic success. Most of the research reviewed showed that

the dropout research is usually concerned with completely dropping out of college or total programs. The study carried out by Szabo and Feldhusen[5] was typical of the research involving specific courses in that they were concerned with predicting academic success. My major concern is to attempt to minimize dropouts and maximize success in individual courses.

The results of this study show conclusive evidence that success increases and dropouts decrease as the students progress through mathematics courses. This, of course, is only what is to be expected as a result of the better students progressing further. The separation of the calculus courses from the others at the grade 13 level indicates that some attention is needed here. Either the students prior preparation is lacking, or the teachers of the beginning calculus are expecting too much from the students. This is an area in need of further investigation.

The Chi-square analysis revealed a very significant difference in probabilities of success, failure and dropout dependent upon the teacher involved. Furthermore, the 95% confidence limits established for the probabilities clearly identified teachers having significantly different probabilities from the total group. This type of analysis could be a very useful tool in determining teacher effectiveness.

These results clearly indicate that the dropout problem is not exclusively the problem of the student or the counselor. Indeed, it is definitely a problem of the teacher as well. This being the case, I intend to attack the problem of minimizing

dropouts and maximizing success through the development and use of self-instructional material for students in my classes.

My recommendation is that every Community College classroom teacher examine the success, failure and dropout rates in his or her classes, and then make a super effort to increase the successes and decrease the dropouts. What I mean is real effort by the teacher, not simply blaming the counselor or the student.

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